BLACKSTONE RIVER FLOOD CONTROL

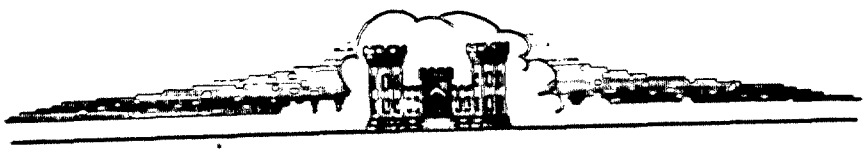
OPERATION AND MAINTENANCE MANUAL

FOR

FLOOD PROTECTION WORKS

BLACKSTONE, MASSACHUSETTS

BLACKSTONE RIVER



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.

AUGUST 1971

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OPERATION

AND

MAINTENANCE

MANUAL

U.S. Army Engineer Division, New England
Corps of Engineers
Waltham, Massachusetts

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FOREWARD

The successful functioning of flood protective works is not assured solely by construction of a system of adequate dikes, diversion channel and other appurtenant structures. If the system is to perform the functions for which it was designed, it must be carefully maintained during periods of normal river stages and properly operated during flood periods.

The need for proper maintenance cannot be too highly stressed in view of the fact that large damages may be incurred through failure of a critical element in flood time, caused by deterioration or damage that would have been eliminated by proper maintenance.

Necessary maintenance and proper operation require that responsible local persons have a thorough understanding of the functions of the various units of the system, and the best methods of maintaining the system and operating it during flood emergencies. It is the purpose of this manual to provide complete information so that all parties may know their responsibilities in maintaining and operating the flood protection system in accordance with the regulations of the Secretary of the Army as amplified by this manual.

The Flood Control Regulations for Maintenance and Operation of Flood Control Works quoted herein were approved by the Acting Secretary of War on 9 August 1944. Upon establishment of the Department of Defense the improvement of rivers and harbors and other waterways for flood control and other purposes, formerly under the jurisdiction of the Secretary of War, became the responsibility of the Secretary of the Army. Reference therein to the Secretary of War and War Department shall be construed to mean, respectively, the Secretary of the Army and Department of the Army. Where reference is made to the District Engineer in the regulations included in this manual, it shall be construed to mean the Division Engineer, U. S. Army Engineer Division, New England, Waltham, Massachusetts.

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SECTION I

INTRODUCTION

1. AUTHORIZATION

Restoration of a local protection project on the Blackstone River at Blackstone, Massachusetts was authorized by the Chief of Engineers on 28 January 1970 pursuant to authority contained in the 1941 Flood Control Act, as amended by Public Law 99, 84th Congress.

2. LOCATION

The project is located in south-central Massachusetts along the right bank of the Blackstone River in the Town of Blackstone. Blackstone is situated in Worcester County on the Massachusetts-Rhode Island boundary just north of the city of Woonsocket, Rhode Island. The Blackstone River basin is located in south-central Massachusetts and northern Rhode Island, and is generally elongated in shape with a length of about 49 miles, average width of 12 miles, and a total drainage area of 540 square miles. The Blackstone River originates northwest of Worcester, Massachusetts, and flows in a southeasterly and southerly direction to the mouth of the estuary in Providence, Rhode Island. The project area along the right bank extends downstream from the St. Paul Street Bridge to the abandoned New York, New Haven & Hartford Railroad embankment.

3. DESCRIPTION OF PROJECT

The project consists primarily of an 860-foot long earth dike with stone protection. The dike ties into an existing floodwall 180 feet downstream of St. Paul Street and blends into the railroad embankment at the downstream end. A town highway garage and existing drainage facilities were removed. Two new drain inlets and pipe outlets to the river with flapgate closures were constructed for the control of interior drainage.

4. PROTECTION PROVIDED

The project will provide overbank flood protection for public properties essential to the welfare of the town of Blackstone. The

dike was designed for flood flows up to 26,000 c.f.s. which equals the August 1955 flood of record.

5. CONSTRUCTION HISTORY

Construction of the project was initiated on 22 August 1970 and was completed 1 June 1971. The project was constructed by Gencarelli, Inc. of Westerly, Rhode Island. Approximate quantities of materials and items used are as follows:

Excavation	9,100	C.Y.
Compacted earth fill	3,500	C.Y.
Compacted gravel fill	2,200	C.Y.
Dumped gravel fill	600	C.Y.
Gravel bedding	1,700	C.Y.
Protection stone	3,300	C.Y.
Topsoiling and seeding	3,600	C.Y.
Drainage facilities	2	Job

6. PLANS

Full-sized tracings of "as built" construction drawings have been provided to the town of Blackstone, and a set of reduced size "as built" drawings showing the project as actually constructed are shown in Appendix E.

SECTION II

LOCAL COOPERATION REQUIREMENTS

7. FLOOD CONTROL ACTS

Section 3 of the Flood Control Act approved 22 June 1936 (Public Law No. 738, 74th Congress) provides "That hereafter no money appropriated under authority of this Act shall be expended on the construction of any project until States, political subdivision thereof, or other responsible local agencies have given assurances satisfactory to the Secretary of War that they will:

"(a) Provide without cost to the United States all lands, easements, and rights-of-way necessary for the construction of the project;

(b) Hold and save the United States free from damages due to the construction works;

(c) Maintain and operate all the works after completion in accordance with regulations prescribed by the Secretary of War."

The Blackstone flood protection works was constructed under authority contained in Public Law 99. Public Law 99, 84th Congress amended the 1941 Flood Control Act and provides for emergency restoration of existing flood control works.

8. ASSURANCES

Assurances were received from the town of Blackstone, signed by the Board of Selectmen on 20 May 1970. In addition, local interests performed and assumed costs assigned to project features other than flood control. A copy of the assurance is included in Appendix B.

SECTION III

GENERAL REGULATIONS

9. PURPOSE OF THIS MANUAL

The purpose of this Manual is to present detailed information to be used as a guide in complying with "Flood Control Regulations - Maintenance and Operation of Flood Control Works" as approved by the Acting Secretary of War on 9 August 1944, and published in this volume as Appendix A. In executing assurances of local cooperation, the Town has agreed to maintain and operate the completed works in accordance with these regulations. The regulations which are intended to cover all local protection projects constructed by the Department throughout the United States, are general in nature, and obviously cannot give detailed instructions for the maintenance and operation of a specific project. The details set forth in this Manual for maintenance and operation of the Blackstone project are intended to supplement the regulations to permit obtaining all the benefits and protection against floods for which the project was designed. Failure to maintain and operate the project as required by the regulations and as detailed herein can cause severe property losses and loss of life and can result in an irreparable loss of confidence in the flood protection system by citizens who have invested their funds on the basis of the protection which it provides.

10. GENERAL RULES AND REGULATIONS

Paragraph 208.10(a) of the regulations prescribed by the Secretary of War gives general rules for the maintenance and operation of structures and facilities constructed by the United States for local flood protection. Applicable portions are quoted below to avoid the necessity for cross reference and are further defined by remarks under each quotation.

"(1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits."

These requirements cannot be overstressed, and the Town authorities must make adequate provisions for funds, personnel, equipment and materials to allow for the proper maintenance and operation of the flood protective works.

"(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent", who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States."

The committee should be composed of competent members, preferably men experienced in engineering or construction work of a nature similar to the flood protection works. The committee must be given broad authority to carry out its responsibilities. The name, address, and office and home telephone numbers of the Superintendent, and any changes thereof, shall be promptly furnished the Division Engineer.

"(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times."

Three men should be available to meet any ordinary emergency that may occur during flood periods. Borrow pits for embankment gravel and rock materials should be secured and sources of additional supplies of materials, tools, and equipment should be well established in order that these articles can be obtained quickly in case of an emergency.

"(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities."

"(5) No improvement shall be passed over, under or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representatives that such improvement, excavation, construction or alteration will not adversely affect the functioning of the protective facilities. Such improvement or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer, or if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work."

"(6) It shall be the duty of the Superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance and operation of the protective works."

"(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works."

The Division Engineer or his representatives will make periodic inspections of the protective works to determine if the project is being properly maintained and operated by the Town.

"(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made."

The Town should maintain the facilities and keep them in good repair and not wait for the Division Engineer to call such matters to its attention. Upon request, the Division Office will advise the Town how to make any repairs to the facilities.

"(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations

operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods."

"(10) The Corps of Engineers will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations."

The flood control committee should familiarize itself with the contents of this manual. The Town authorities are encouraged to call on the Division Office of the Corps of Engineers for any additional advice or instructions required by them in carrying out the Town's obligations for maintaining and operating the flood protection facilities.

11. MAINTENANCE

a. The word "maintenance" as used in this manual applies to the upkeep, repair and care of the work constructed by the United States and turned over to the Town of Blackstone. If the work is neglected there will be deterioration and possible failure in flood time when there is dire need of dependable protection.

b. Satisfactory and dependable operation depends on constant maintenance. The organization that performs maintenance will be familiar with various parts of the system and will be in a position to use them effectively in time of stress.

c. Maintenance includes regular inspection of the entire system. The purpose of an inspection is to detect any deterioration or faulty operation that indicates a need for repair or replacement.

d. Each of the major features of the project will be discussed separately with respect to the points which, based on experience with special project features, require special attention.

12. OPERATION

Operation in this manual refers to the actual use of the various features of the protection works during flood periods. It is intended

that the procedure outlined herein will be sufficient to insure protection from floods to the designed flood stage. However, advice relative to operation may be obtained at any time from the Engineering Division of the New England Division Office.

13. REPORTS

a. The regulations prescribed by the Secretary of War call for semiannual reports to be submitted by the Superintendent to the Division Engineer, covering inspection, maintenance and operation. Inspection of the flood protective facilities shall be made immediately prior to flood seasons, immediately following floods and otherwise at intervals not exceeding 90 days as required by the regulations.

b. To assist the Superintendent in making his inspections and reports, sample forms have been prepared and are included in Appendix C. The Superintendent shall have additional copies printed for use in submitting his reports.

c. The semiannual reports should be submitted in triplicate to the Division Engineer each February and August. The reports will be submitted in letter form with copies of the inspection forms covering the inspections made during the period of the report. The reports shall cover the following points:

(1) A description of the maintenance work performed in the preceding six months.

(2) The number and classification of men working on maintenance regularly and intermittently.

(3) Description of any work performed by contract on the repair or improvement of the project.

(4) Description of use or operation of the system during the period being reported.

(5) Suggestions relative to public cooperation and comments concerning public sentiment on the protection obtained are considered pertinent and desirable data for inclusion in the report, but such data are not required.

SECTION IV

DIKES

14. DESCRIPTION

The dike is composed of compacted earth fill with side slopes of 1 vertical on 2 horizontal. It has 18 inches of rock slope protection to elevation 160 (msl) and grassed slopes above, on top, and on the land side. The dike is 863 feet in length, varies in height up to 7 feet, and is 12 feet wide on top. Two 15-inch diameter pipe drains with flap valves extend through the dike.

15. MAINTENANCE

Paragraph 208.10(b)(1) of the prescribed regulations sets forth rules for the maintenance of levees. These rules apply equally to earth dikes, and applicable portions are quoted below.

"Levees. - (1) Maintenance. - The Superintendent shall provide at all times, such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, to exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out, and further, to be certain that:

"(i) No unusual settlement, sloughing or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) _____ Not applicable _____.

(v) Drains through the levees and gates on said drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) _____Not applicable_____.

(ix) _____Not applicable_____.

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during time of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days; and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent."

Any unusual settlement, sloughing or caving should be corrected to restore the original dike grades. No major repair work shall be made without prior approval of the Division Engineer in order that such repairs that may be necessary will not adversely affect the functioning of the protective facilities.

Inspections of the dike shall be made during and after periods of high water, as it is at such time that any weak spots will be discovered that might otherwise be overlooked.

16. OPERATION

a. Paragraph 208.10(b)(2) of the prescribed regulations sets forth rules for the operation of the levees. These rules apply equally to earth dikes and are quoted below.

"(2) Operation. - During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section."

Patrolling the dikes should start when water reaches Elevation 160 mean sea level (msl) and should continue until the flood has reached its peak and receded below elevation 160 msl. Patrolmen should be thoroughly instructed as to their duties, what they are to watch for, and the exact limits of their beat.

17. EMERGENCY REPAIR MEASURES

a. Scours. - Careful watch should be maintained over stretches of the dike where scouring is likely to occur, particularly at curves in the alignment where the dike is subject to heavy currents. If any indication of scouring is observed, soundings should be taken to observe the amount and progress of the scour. Sandbagging or dumped rock will generally afford the most practicable means of combatting this condition. The open ends of sandbags so used must be sewed or tied after filling with earth.

b. Sand boils

(1) General. - A sand boil is the result of a transfer of pressure head and seepage from the river through a pervious stratum near or at the surface to the landside of the levee. This seepage under pressure tends to push its way to the surface and actually floats the material through which it flows. No harmful effect results provided the weight of the relatively impervious soil layer overlying the pervious stratum, in which the flow under pressure is occurring, is sufficient to counterbalance this pressure. When the soil stratum overlying the pervious layer is insufficient to counterbalance the upward pressure or when no such stratum exists, boils break through the surface on the landside wherever these weaknesses are present. The sand boil may discharge relatively clear water or the discharge may contain quantities of sand and silt, depending upon the magnitude of the pressure and the size of the boil.

(2) Effects of Sand Boils. - Sand boils can produce three distinctly different effects on the levee, depending upon the condition of flow under the levee. These three effects are illustrated in Appendix D. In Figure 1, Plate No. 1, the seepage flow develops a definite pipe or tube under the levee. This breaks out at the landside toe in the form of one or more large sand boils. Unless checked, this flow causes a cavern to be developed under the levee, resulting in subsidence of the levee and subsequent overtopping. This case can be most easily recognized by slumping of the levee crown. Figure 2, Plate No. 1, illustrates the case where seepage flows under pressure under the levee without following a defined path, as was the case above. This flow results in one or more boils outcropping at or near the landside toe. The flow from these boils tends to undercut and ravel the slope, resulting in a sloughing of the slope. Evidence of this type of failure is found in undercutting and ravelling at the landside toe. Figure 3, Plate No. 1, shows a third type of effect of a sand boil. In this case, numerous small boils, many of which are scarcely noticeable, outcrop at or near the toe. While no boil may appear to be dangerous in itself, the consequence of the group of boils is to cause flotation of the soil, thereby reducing the shearing strength of the material at the toe, where maximum shearing stress occurs, to such an extent that failure of the slope through sliding results.

(3) General Instructions for Handling Sand Boils. - All sand boils shall be watched closely. All boils shall be marked conspicuously with flagging so that patrols can locate them without difficulty and observe changes in their condition. A sand boil which discharges clear water in a steady flow is usually not dangerous to the safety of the levee. The only action necessary in this case is to drain the excess water off to prevent it from standing near the levee. However, if the flow of water increases, and the sand boil begins to discharge material, corrective action shall be undertaken immediately.

(4) Method of Treatment

(a) The accepted method of treating sand boils is to construct a ring of sand bags around the boil, building up a head of water within the ring sufficient to prevent further movement of sand and silt. The accepted method of ringing a sand boil, shown on Plate No. II of Appendix D, is as follows:

1. The entire base of the sack ring is cleared of debris, in order to provide a watertight bond between the natural ground and the sack ring.

2. The sacks are then laid in a ring around the boil with joints staggered, and with loose earth between all sacks.

3. The ring is carried only to a height sufficient to prevent material from being discharged. The ring should not entirely stop the flow of water, because of the probability of the excessive local pressure head causing additional ruptures of impervious strata and boils nearby.

4. A "V" shaped drain constructed of two boards or a piece of sheet metal, is then placed near the top of the ring to carry off the water.

(b) Actual conditions at each sand boil will determine the exact dimensions of the ring. The diameter and height of the ring depend on the size of the boil, and the flow of water from it. In general, the following considerations should govern:

1. The base width should be no less than 1 1/2 times the contemplated height.

2. It is well to include weak ground near the boil within the ring, thereby preventing a break-through later.

3. The ring should be of sufficient size to permit sacking operations to keep ahead of the flow of water.

(c) Where many boils are found to exist in a given area, a ring levee of sandbags shall be constructed around the entire area and, if necessary, water pumped into the area to provide sufficient weight to counterbalance the upward pressure.

d. Sloughs. - During prolonged high water stages, seeping and sloughing conditions on the back slopes may occur. Such conditions should be observed closely as to progress of seepage up the back slope and the amount of material that is being carried by the water. If the seep velocity becomes great enough to cause, or probably cause, erosion or sloughing of the slope, a sandbag covering should be placed on the seeping area, beginning well out from the toe and progressing up the slope. The covering should extend several feet beyond the saturated area. If the material is obtainable, the affected area should be covered with brush, straw or similar permeable material to a depth of two to four inches before placing the sandbag cover. This will permit the seep water to get away while serving as a filter to prevent loss of earth from the dike. After the covering is placed, close observation should be maintained and additional layers of sandbags placed on the previous ones until the velocity of the seepage is reduced to a point at which the amount of material carried is negligible. Sacking sloughs are illustrated on Plate No. III of Appendix D.

e. Raising Existing Earth Dikes. - In an emergency, time and other conditions permitting, the grade of a dike can be safely raised three feet. The methods most commonly used for this purpose are outlined in the following paragraphs.

(1) Sandbag topping. - The sack ordinarily used for topping an earth dike is a grain or feed sack which holds 100 pounds. Smaller sacks may be used if feed sacks are not available. Grain sacks, filled with about one cubic foot of earth, weighing about 100 pounds, will provide a unit about six inches high, one foot wide and two feet in length.

The sacks may be filled at the source of material and hauled to the dike or filled from stockpile or borrow areas at the dike, conditions determining the method employed. The same is true of filling; i.e., whether power or hand methods are used. The open end of the sacks should always face upstream or toward the riverside of the dike and need not be sewed or tied. When the sack faces the river the loose end should be folded under and when facing upstream the loose end covered by the succeeding sack.

The front line of sandbags in the first layer should be laid parallel to the dike centerline and remaining bags at right angles to the centerline. The sandbags in the second layer are all laid at right angles to the centerline, the third row similar to the first, etc., as shown on Plate No. IV of Appendix D. All sacks should be lapped about 1/3 each way and well mauled or tramped into place. The sacks should be filled to 2/3 their capacity when flattened out to facilitate proper placing and prevent bursting the sack when mauled or tramped into place.

Plate No. IV illustrates the progressive method of increasing the dike height and gives an approximation of the number of sacks required for dikes of various heights. Plate No. V shows pictures of model sack dike or topping.

A crew of 50 men should fill, carry and place approximately 1500 sacks per eight-hour day, all hand labor, when the source of material is within 150 feet of the point of placement. Production will depend on conditions at the site.

(2) Lumber and sandbag topping. - This is the most satisfactory method of raising low reaches of earth dike in emergencies. The chief objection is the time required to install. In putting on this topping, as well as any other topping, a careful line of levels should be run and grade stakes set in advance unless the dike top follows a dependable grade-line. Two-by-four or two-by six inch stakes should then be driven on the riverside of the crown six feet apart and one-by-twelve inch boards nailed to landside of the stakes. This wall, backed with a single tier of sandbags, will hold out at least one foot of water. If the second foot is necessary, the layers of bags will have to be increased in number and reinforced. Sandbags are laid substantially in the manner described in (1) above. The stakes should be driven at least three feet into the ground, leaving at least three feet out, which will, in extreme cases, hold a three-foot topping

if properly braced behind with sandbags. Plate No. VI, Appendix D illustrates this method of raising a dike.

SECTION V

DRAINAGE STRUCTURES

18. DESCRIPTION

Two 15-inch diameter concrete pipe culverts through the dike are provided to drain the interior surface water. Cast iron flap valves are provided on the river side of the dike.

19. MAINTENANCE

"Normal maintenance as required for this type of structure should be performed. Adequate measures shall be taken to insure that the flap valve is kept free of trash, drift or debris that would interfere with the operation of the flap valve. Regular inspection shall be made by the Superintendent to be certain that:

(1) Pipes, gate, operating mechanism and riprap are in good condition.

(2) Inlet and outlet are open.

(3) Care is being exercised to prevent the accumulation of trash and debris near the structures, and that no fires are being built near the bituminous coated pipe.

(4) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections."

20. OPERATION

Whenever high water conditions impend, the flap valve shall be inspected a short time before water reaches the invert of the pipe, and any object which might prevent closure of the valve shall be removed.

SECTION VI

DRAWINGS AND SPECIFICATIONS

21. DRAWINGS AND SPECIFICATIONS

A complete set of plans and specifications was furnished the town of Blackstone, The Commonwealth of Massachusetts and other interested state agencies at the time of initiation of construction of the project. A full-size set of plans showing the project as actually constructed was furnished the town at the time of transmittal of this manual. Reduced prints of these drawings are included in Appendix E.

APPENDIX A

REGULATIONS OF THE SECRETARY OF THE ARMY

TITLE 33—NAVIGATION AND NAVIGABLE WATERS

Chapter II—Corps of Engineers, War Department

PART 208—FLOOD CONTROL REGULATIONS

MAINTENANCE AND OPERATION OF FLOOD CONTROL WORKS

Pursuant to the provisions of section 3 of the Act of Congress approved June 22, 1936, as amended and supplemented (49 Stat. 1571; 50 Stat. 877; and 55 Stat. 638; 33 U. S. C. 701c; 701c-1), the following regulations are hereby prescribed to govern the maintenance and operation of flood control works:

§ 208.10 *Local flood protection works; maintenance and operation of structures and facilities*—(a) *General.* (1) The structures and facilities constructed by the United States for local flood protection shall be continuously maintained in such a manner and operated at such times and for such periods as may be necessary to obtain the maximum benefits.

(2) The State, political subdivision thereof, or other responsible local agency, which furnished assurance that it will maintain and operate flood control works in accordance with regulations prescribed by the Secretary of War, as required by law, shall appoint a permanent committee consisting of or headed by an official hereinafter called the "Superintendent," who shall be responsible for the development and maintenance of, and directly in charge of, an organization responsible for the efficient operation and maintenance of all of the structures and facilities during flood periods and for continuous inspection and maintenance of the project works during periods of low water, all without cost to the United States.

(3) A reserve supply of materials needed during a flood emergency shall be kept on hand at all times.

(4) No encroachment or trespass which will adversely affect the efficient operation or maintenance of the project works shall be permitted upon the rights-of-way for the protective facilities.

(5) No improvement shall be passed over, under, or through the walls, levees, improved channels or floodways, nor shall any excavation or construction be permitted within the limits of the project right-of-way, nor shall any change be made in any feature of the works without prior determination by the District Engineer of the War Department or his authorized representative that such improvement, excavation, construction, or alteration will not adversely affect the functioning of the protective facilities. Such improvements or alterations as may be found to be desirable and permissible under the above determination shall be constructed in accordance with standard engineering practice. Advice regarding the effect of proposed improvements or alterations on the functioning of the project and information concerning methods of construction acceptable under standard engineering practice shall be obtained from the District Engineer or, if otherwise obtained, shall be submitted for his approval. Drawings or prints showing such improvements or alterations as finally constructed shall be furnished the District Engineer after completion of the work.

(6) It shall be the duty of the superintendent to submit a semiannual report to the District Engineer covering inspection, maintenance, and operation of the protective works.

(7) The District Engineer or his authorized representatives shall have access at all times to all portions of the protective works.

(8) Maintenance measures or repairs which the District Engineer deems necessary shall be promptly taken or made.

(9) Appropriate measures shall be taken by local authorities to insure that the activities of all local organizations operating public or private facilities connected with the protective works are coordinated with those of the Superintendent's organization during flood periods.

(10) The War Department will furnish local interests with an Operation and Maintenance Manual for each completed project, or separate useful part thereof, to assist them in carrying out their obligations under these regulations.

(b) *Levees*—(1) *Maintenance.* The Superintendent shall provide at all times such maintenance as may be required to insure serviceability of the structures in time of flood. Measures shall be taken to promote the growth of sod, exterminate burrowing animals, and to provide for routine mowing of the grass and weeds, removal of wild growth and drift deposits, and repair of damage caused by erosion or other forces. Where practicable, measures shall be taken to retard bank erosion by planting of willows or other suitable growth on areas riverward of the levees. Periodic inspections shall be made by the Superintendent to insure that the above maintenance measures are being effectively carried out and, further, to be certain that:

(i) No unusual settlement, sloughing, or material loss of grade or levee cross section has taken place;

(ii) No caving has occurred on either the land side or the river side of the levee which might affect the stability of the levee section;

(iii) No seepage, saturated areas, or sand boils are occurring;

(iv) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged;

(v) Drains through the levees and gates on sold drains are in good working condition;

(vi) No revetment work or riprap has been displaced, washed out, or removed;

(vii) No action is being taken, such as burning grass and weeds during inappropriate seasons, which will retard or destroy the growth of sod;

(viii) Access roads to and on the levee are being properly maintained;

(ix) Cattle guards and gates are in good condition;

(x) Crown of levee is shaped so as to drain readily, and roadway thereon, if any, is well shaped and maintained;

(xi) There is no unauthorized grazing or vehicular traffic on the levees;

(xii) Encroachments are not being made on the levee right-of-way which might endanger the structure or hinder its proper and efficient functioning during times of emergency.

Such inspections shall be made immediately prior to the beginning of the flood season; immediately following each major high water period, and otherwise at intervals not exceeding 90 days, and such intermediate times as may be necessary to insure the best possible care of the levee. Immediate steps will be taken to correct dangerous conditions disclosed by such inspections. Regular maintenance repair measures shall be accomplished during the appropriate season as scheduled by the Superintendent.

(2) *Operation.* During flood periods the levee shall be patrolled continuously to locate possible sand boils or unusual wetness of the landward slope and to be certain that:

(i) There are no indications of slides or sloughs developing;

(ii) Wave wash or scouring action is not occurring;

(iii) No low reaches of levee exist which may be overtopped;

(iv) No other conditions exist which might endanger the structure.

Appropriate advance measures will be taken to insure the availability of adequate labor and materials to meet all contingencies. Immediate steps will be taken to control any condition which endangers the levee and to repair the damaged section.

(c) *Flood walls.*—(1) *Maintenance.* Periodic inspections shall be made by the Superintendent to be certain that:

(i) No seepage, saturated areas, or sand boils are occurring;

(ii) No undue settlement has occurred which affects the stability of the wall or its water tightness;

(iii) No trees exist, the roots of which might extend under the wall and offer accelerated seepage paths;

(iv) The concrete has not undergone cracking, chipping, or breaking to an extent which might affect the stability of the wall or its water tightness;

(v) There are no encroachments upon the right-of-way which might endanger the structure or hinder its functioning in time of flood;

(vi) Care is being exercised to prevent accumulation of trash and debris adjacent to walls, and to insure that no fires are being built near them;

(vii) No bank caving conditions exist riverward of the wall which might endanger its stability;

(viii) Toe drainage systems and pressure relief wells are in good working condition, and that such facilities are not becoming clogged.

Such inspections shall be made immediately prior to the beginning of the flood season, immediately following each major high water period, and otherwise at intervals not exceeding 90 days. Measures to eliminate encroachments and effect repairs found necessary by such inspections shall be undertaken immediately. All repairs shall be accomplished by methods acceptable in standard engineering practice.

(2) *Operation.* Continuous patrol of the wall shall be maintained during flood periods to locate possible leakage at monolith joints or seepage underneath the wall. Floating plant or boats will not be allowed to lie against or tie up to the wall. Should it become necessary during a flood emergency to pass anchor cables over the wall, adequate measures shall be taken to protect the concrete and construction joints. Immediate steps shall be taken to correct any condition which endangers the stability of the wall.

(d) *Drainage structures*—(1) *Maintenance.* Adequate measures shall be taken to insure that inlet and outlet channels are kept open and that trash, drift, or debris is not allowed to accumulate near drainage structures. Flap gates and manually operated gates and valves on

drainage structures shall be examined, oiled, and trial operated at least once every 90 days. Where drainage structures are provided with stop log or other emergency closures, the condition of the equipment and its housing shall be inspected regularly and a trial installation of the emergency closure shall be made at least once each year. Periodic inspections shall be made by the Superintendent to be certain that:

(i) Pipes, gates, operating mechanism, riprap, and headwalls are in good condition;

(ii) Inlet and outlet channels are open;

(iii) Care is being exercised to prevent the accumulation of trash and debris near the structures and that no fires are being built near bituminous coated pipes;

(iv) Erosion is not occurring adjacent to the structure which might endanger its water tightness or stability.

Immediate steps will be taken to repair damage, replace missing or broken parts, or remedy adverse conditions disclosed by such inspections.

(2) *Operation.* Whenever high water conditions impend, all gates will be inspected a short time before water reaches the invert of the pipe and any object which might prevent closure of the gate shall be removed. Automatic gates shall be closely observed until it has been ascertained that they are securely closed. Manually operated gates and valves shall be closed as necessary to prevent inflow of flood water. All drainage structures in levees shall be inspected frequently during floods to ascertain whether seepage is taking place along the lines of their contact with the embankment. Immediate steps shall be taken to correct any adverse condition.

(e) *Closure structures*—(1) *Maintenance.* Closure structures for traffic openings shall be inspected by the superintendent every 90 days to be certain that:

(i) No parts are missing;

(ii) Metal parts are adequately covered with paint;

(iii) All movable parts are in satisfactory working order,

(iv) Proper closure can be made promptly when necessary;

(v) Sufficient materials are on hand for the erection of sand bag closures and that the location of such materials will be readily accessible in times of emergency.

Tools and parts shall not be removed for other use. Trial erections of one or more closure structures shall be made once each year, alternating the structures chosen so that each gate will be erected at least once in each 3-year period. Trial erection of all closure structures shall be made whenever a change is made in key operating personnel. Where railroad operation makes trial erection of a closure structure infeasible, rigorous inspection and drill of operating personnel may be substituted therefor. Trial erection of sand bag closures is not required. Closure materials will be carefully checked prior to and following flood periods, and damaged or missing parts shall be repaired or replaced immediately.

(2) *Operation.* Erection of each movable closure shall be started in sufficient time to permit completion before flood waters reach the top of the structure sill. Information regarding the proper method of erecting each individual closure structure, together with an estimate of the time required by an experienced crew to complete its erection will be given in the Operation and Maintenance Manual which will be furnished local interests upon completion of the project. Closure structures will be inspected frequently during flood periods to ascertain that no undue leakage is occurring and that drains provided to care for ordinary leakage are functioning properly. Boats or floating plant shall not be allowed to tie up to closure structures or to discharge passengers or cargo over them.

(f) *Pumping plants*—(1) *Maintenance.* Pumping plants shall be inspected by the Superintendent at intervals not to exceed 30 days during flood seasons and 90 days during off-flood seasons to insure that all equipment is in order for instant use. At regular intervals, proper measures shall be taken to provide for cleaning plant, buildings, and equipment, repainting as necessary, and lubricating all machinery Adequate supplies of lubricants for all types of machines, fuel for gasoline or diesel powered equipment, and flash lights or lanterns for emergency lighting shall be kept on hand at all times. Telephone service shall be maintained at pumping plants. All equipment, including switch gear, transformers, motors, pumps, valves, and gates shall be trial operated and checked at least once every 90 days. Megger tests of all insulation shall be made whenever wiring has been subjected to undue dampness and otherwise at intervals not to exceed one year. A record shall be kept showing the results of such tests. Wiring disclosed to be in an unsatisfactory condition by such tests shall be brought to a satisfactory condition or shall be promptly replaced. Diesel and gasoline engines shall be started at such intervals and allowed to run for such length of time as may be necessary to insure their serviceability in times of emergency. Only skilled electricians and mechanics shall be employed on tests and repairs. Operating personnel for the plant shall be present during tests. Any equipment removed from the station for repair or replacement shall be returned or replaced as soon as practicable and shall be trial operated after reinstallation. Repairs requiring removal of equipment from the plant shall be made during off-flood seasons insofar as practicable.

(2) *Operation.* Competent operators shall be on duty at pumping plants whenever it appears that necessity for pump operation is imminent. The operator shall thoroughly inspect, trial operate, and place in readiness all plant equipment. The operator shall be familiar with the equipment manufacturers' instructions and drawings and with the "Operating Instructions" for each station. The equipment shall be operated in accordance with the above-mentioned "Operating Instructions" and care shall be exercised that proper lubrication is being supplied all equipment, and that no overheating, undue vibration or noise is occurring. Immediately upon final recession of flood waters, the pumping station shall be thoroughly cleaned, pump house sumps flushed, and equipment thoroughly inspected, oiled and greased. A record or log of pumping plant operation shall be kept for each station, a copy of which shall be furnished the District Engineer following each flood.

(g) *Channels and floodways* — (1) *Maintenance.* Periodic inspections of improved channels and floodways shall be made by the Superintendent to be certain that:

(i) The channel or floodway is clear of debris, weeds, and wild growth;

(ii) The channel or floodway is not being restricted by the depositing of waste materials, building of unauthorized structures or other encroachments;

(iii) The capacity of the channel or floodway is not being reduced by the formation of shoals;

(iv) Banks are not being damaged by rain or wave wash, and that no sloughing of banks has occurred;

(v) Riprap sections and deflection dikes and walls are in good condition;

(vi) Approach and egress channels adjacent to the improved channel or floodway are sufficiently clear of obstructions and debris to permit proper functioning of the project works.

Such inspections shall be made prior to the beginning of the flood season and otherwise at intervals not to exceed 90 days. Immediate steps will be taken to remedy any adverse conditions disclosed by such inspections. Measures will be taken by the Superintendent to promote the growth of grass on bank slopes and earth deflection dikes. The Superintendent shall provide for periodic repair and cleaning of debris basins, check dams, and related structures as may be necessary.

(2) *Operation.* Both banks of the channel shall be patrolled during periods of high water, and measures shall be taken to protect those reaches being attacked by the current or by wave wash. Appropriate measures shall be taken to prevent the formation of jams of ice or debris. Large objects which become lodged against the bank shall be removed. The improved channel or floodway shall be thoroughly inspected immediately following each major high water period. As soon as practicable thereafter, all snags and other debris shall be removed and all damage to banks, riprap, deflection dikes and walls, drainage outlets, or other flood control structures repaired.

(h) *Miscellaneous facilities* — (1) *Maintenance.* Miscellaneous structures and facilities constructed as a part of the protective works and other structures and facilities which function as a part of, or affect the efficient functioning of the protective works, shall be periodically inspected by the Superintendent and appropriate maintenance measures taken. Damaged or unserviceable parts shall be repaired or replaced without delay. Areas used for ponding in connection with pumping plants or for temporary storage of interior run-off during flood periods shall not be allowed to become filled with silt, debris, or dumped material. The Superintendent shall take proper steps to prevent restriction of bridge openings and, where practicable, shall provide for temporary raising during floods of bridges which restrict channel capacities during high flows.

(2) *Operation.* Miscellaneous facilities shall be operated to prevent or reduce flooding during periods of high water. Those facilities constructed as a part of the protective works shall not be used for purposes other than flood protection without approval of the District Engineer unless designed therefor. (49 Stat. 1571, 50 Stat. 877; and 55 Stat. 638; 33 U.S.C. 701c; 701c–1) (Regs. 9 August 1944, CE SPEWF)

[SEAL] J. A. ULIO,
Major General,
The Adjutant General.

[F. R. Doc. 44–12285; Filed, August 16, 1944; 9:44 a. m.]

APPENDIX B

ASSURANCES OF LOCAL COOPERATION

APPROVED BY:

ENGRG DIV

OFFICE OF COUNSEL

REAL EST DIV

ASSURANCE

OF THE

TOWN OF BLACKSTONE

WHEREAS, the Blackstone Flood Control Restoration Project, Blackstone, Massachusetts, approved under date of 28 January 1970 by the Chief of Engineers under authority granted by the 1941 Flood Control Act, as amended by Public Law 99, 84th Congress, provides for restoration of a floodwall which consists of removing the damaged portion of said floodwall and constructing an earth dike that will begin about 180 feet downstream of St. Paul Street and follow parallel to the river and connect to the railroad embankment. The dike will have a 12-foot top width and 1 vertical on 2 horizontal side slopes; and

WHEREAS, the first cost of construction for this restoration is presently estimated at $146,000.00, including estimated non-Federal costs of $9,000.00 for accomplishment of Item a below; and

WHEREAS, the proposed restoration is approved subject to the conditions that local interests execute certain assurances satisfactory to the Secretary of the Army; and

WHEREAS, local interests desiring the prosecution of the project are agreeable to executing said assurances;

NOW, THEREFORE, the Town of Blackstone, acting by and through its Board of Selectmen, duly authorized, hereby assures the United States of America that it will:

a. Provide, without cost to the United States, all lands, easements and rights-of-way, utility and basketball court relocations and alterations necessary for project construction, including disposal areas and removal of the town highway garage;

b. Hold and save the United States free from damages due to the construction works;

c. Maintain and operate the project after completion without cost to the United States in accordance with regulations prescribed by the Secretary of the Army, currently estimated at $300.00 per year; and

d. Prevent future encroachment which might interfere with proper functioning of the project for flood control.

IN WITNESS WHEREOF, the Town of Blackstone, acting by and through its Board of Selectmen, has caused the within Assurance to be executed and its seal affixed hereto, this 21st day of May, 1970.

TOWN OF BLACKSTONE

By _____

_____

_____

ACCEPTANCE

The within Assurance is hereby accepted for and on behalf of the United States of America.

25 May 1970

Frank P Bane

FRANK P. BANE
Colonel, Corps of Engineers
Division Engineer

CERTIFICATE

I, Michael J. Ryan Jr., do hereby certify that I am the Town Clerk of the Town of Blackstone named herein; that Raymond E. Trottier Richard A. Ryan, and Robert A. Lambrche, who signed this Assurance on behalf of the Town, were then and there, the members of the Board of Selectmen of the Town of Blackstone, by virtue of their authority, and is within the scope of their statutory powers.

IN WITNESS WHEREOF, I have hereunto affixed my hand and seal of the Town of Blackstone, this 26th day of May, 1970.

Michael J. Ryan Jr.
TOWN CLERK

APPENDIX C

INSPECTION REPORT FORMS

LOCAL FLOOD PROTECTION PROJECT INSPECTION REPORT

Project:

Maintaining Agency:

Type Inspection: _____Semi-Annual Staff ____90 Day Interim

River Basin: Date of Inspection

Feature	Sat	Unsat	Deficiencies
PUMPING STATIONS - STRUCTURES			
INTERIOR			
EXTERIOR			
PUMPS - MOTORS - ENGINES			
TRIAL OPERATED			
GENERAL CONDITION			
POWER SOURCE			
INSULATION TESTS			
METAL INTAKES/OUTLETS			
GATE VALVES			
GATES - DRAINAGE STRUCTURES			
TRIAL OPERATED			
GENERAL CONDITION			
LUBRICATION			
DIKES - DAMS			
GENERAL CONDITION			
SLOPES/EROSION			
SAND BOILS/CAVING			
TRESPASSING			
SLOPE PROTECTION			
DRAINS			
STOP-LOGS - LOG BOOM			
CONDITION OF LOGS			
AVAILABILITY OF LOGS			
HIGHWAY SLOTS			
STORAGE FACILITIES			
CHANNELS - OUTLET WORKS CHANNEL			
BANKS			
OBSTRUCTION CONTROL			

Feature	Sat	Unsat	Deficiencies
CONCRETE STRUCTURES			
SURFACE			
SETTLEMENT			
JOINTS			
DRAINS			
MISCELLANEOUS			
EMERGENCY OPER. PLAN			
EMERGENCY EQUIPMENT			
SEMI-ANNUAL REPORT			

Inspection Party:

Photographs Taken:

Remarks & Additional Comments:

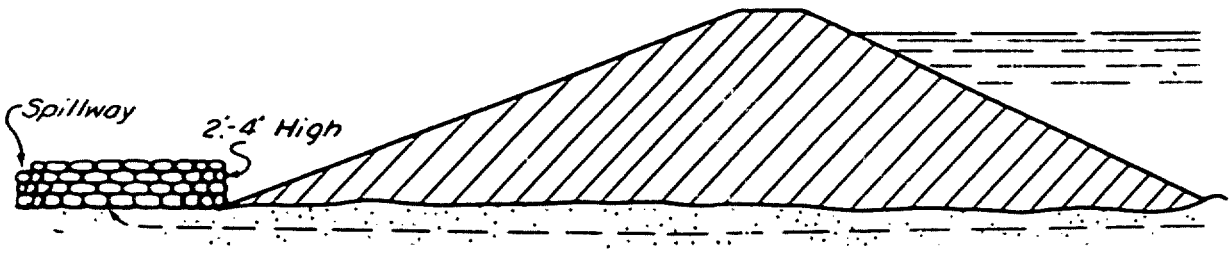
(Indicate Here Observations, Discussions, Specific Feature Deficiencies, Recommendations and any other pertinent information. Use Continuation Sheet if necessary.)

ALL APPLICABLE ITEMS. IF UNSAT INDICATE SPECIFIC DEFICIENCIES. INDICATE IF NOT APPLICABLE.

DATE	INSPECTED BY: TYPED NAME & TITLE	SIGNATURE

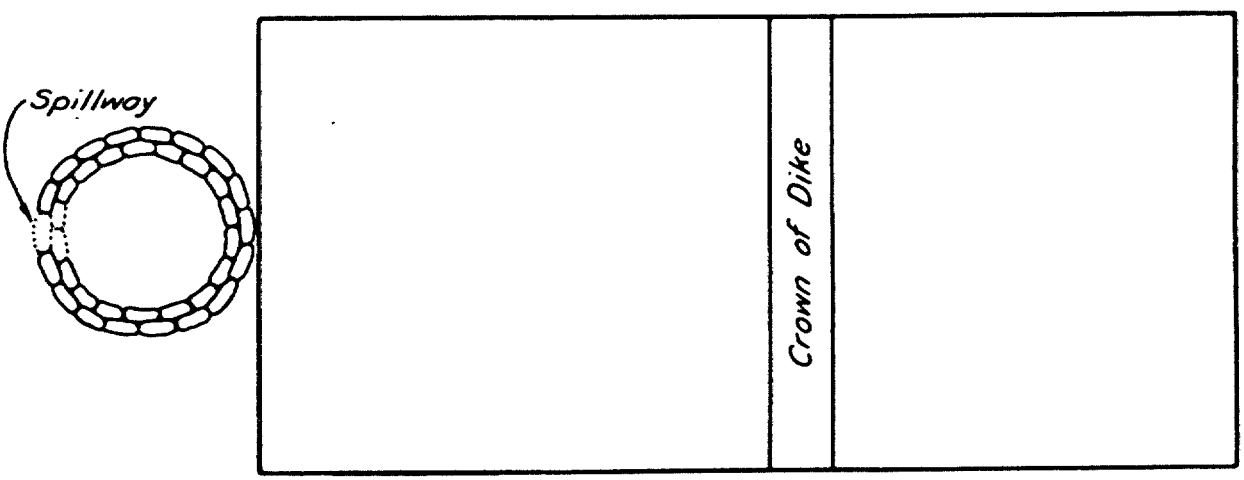
APPENDIX D

FLOOD EMERGENCY MEASURES



ELEVATION

Wall should be built on firm foundation, with width of base at least 1½ times the height.
Be sure to place sacks on ground clear of sand discharge.
Tie into dike if boil is near toe.



PLAN

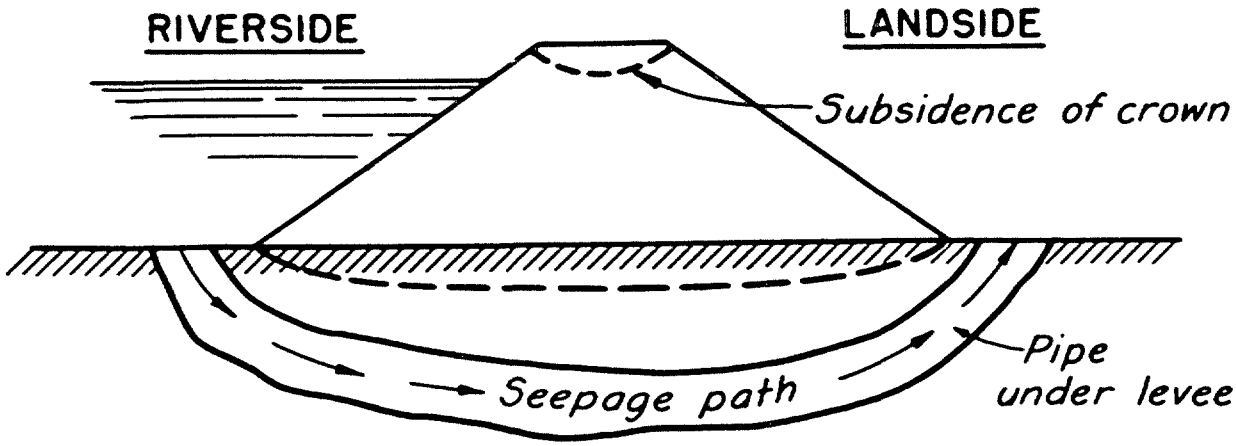
Do not sack boil which does not put out material. Height of sack loop or ring should be only sufficient to create enough head to slow down flow through boil so that no more material is displaced and boil runs clear. Do not try to stop fully, flow through boil.

SAND BOIL
STANDARD HIGH WATER
MAINTENANCE INSTRUCTION

NEW ENGLAND DIVISION

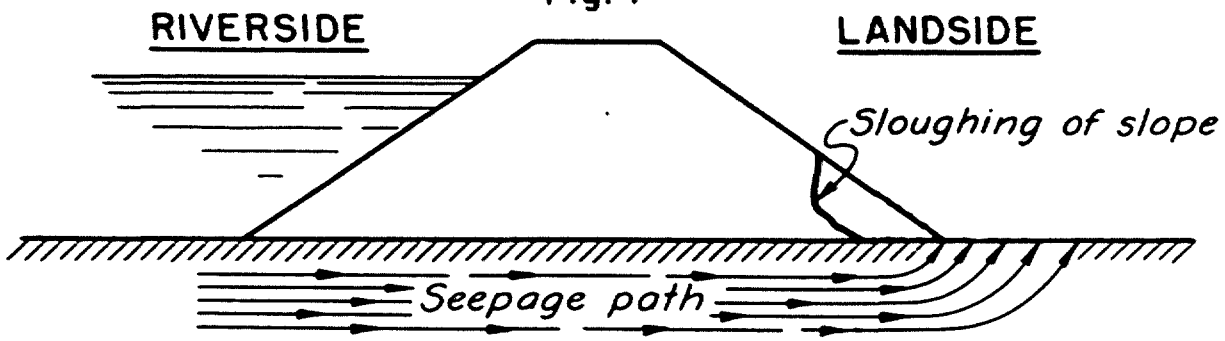
DISASTER OPERATING PROCEDURES
"FLOOD FIGHTING"
ANNEX A

PLATE VII A



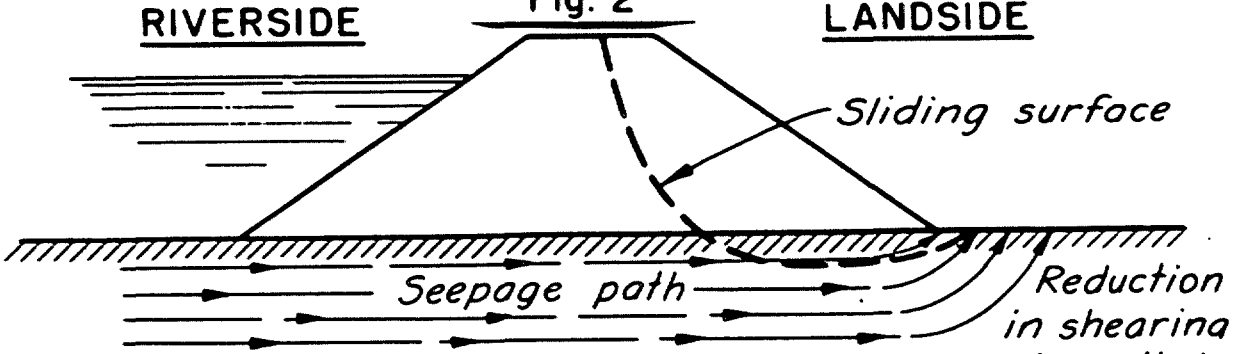
DEVELOPMENT OF PIPE UNDER LEVEE

Fig. 1



SLOUGHING OF LANDSLIDE SLOPE DUE TO RAVELLING AND UNDERCUTTING OF TOE

Fig. 2



DEVELOPMENT OF SHEAR SLIDE

Fig. 3

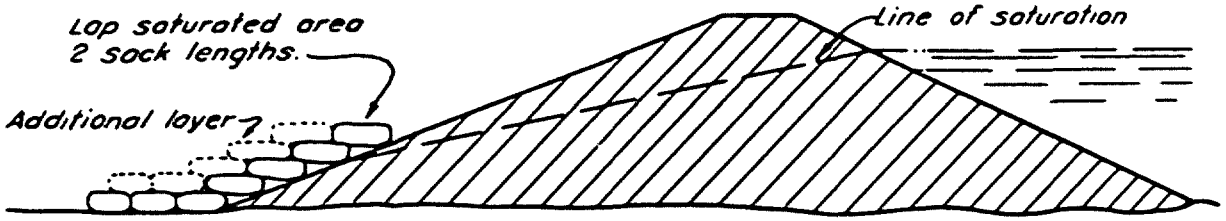
EFFECTS OF SAND BOILS ON LEVEE

NEW ENGL AND DIVISION

DISASTER OPERATING PROCEDURES

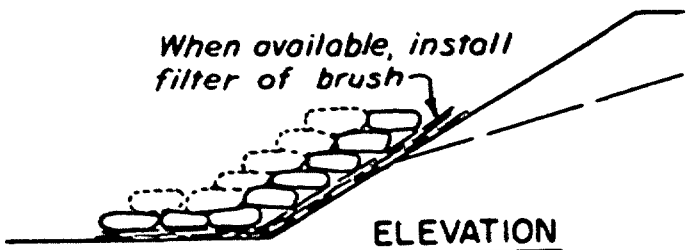
"FLOOD FIGHTING"

ANNEX A PLATE VII B

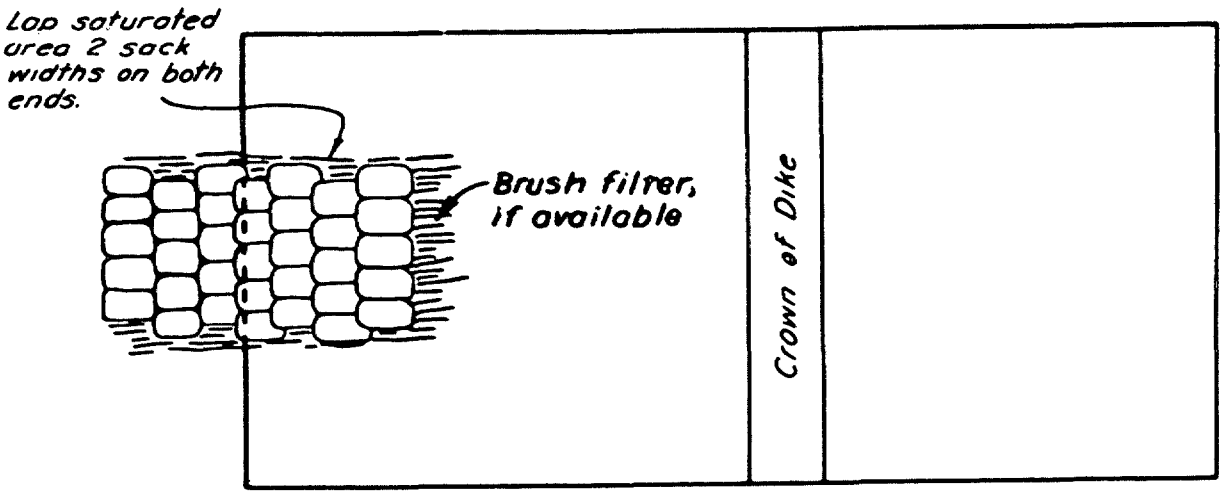


ELEVATION

Number of layers determined by velocity of seepage and amount of material being carried



ELEVATION



PLAN

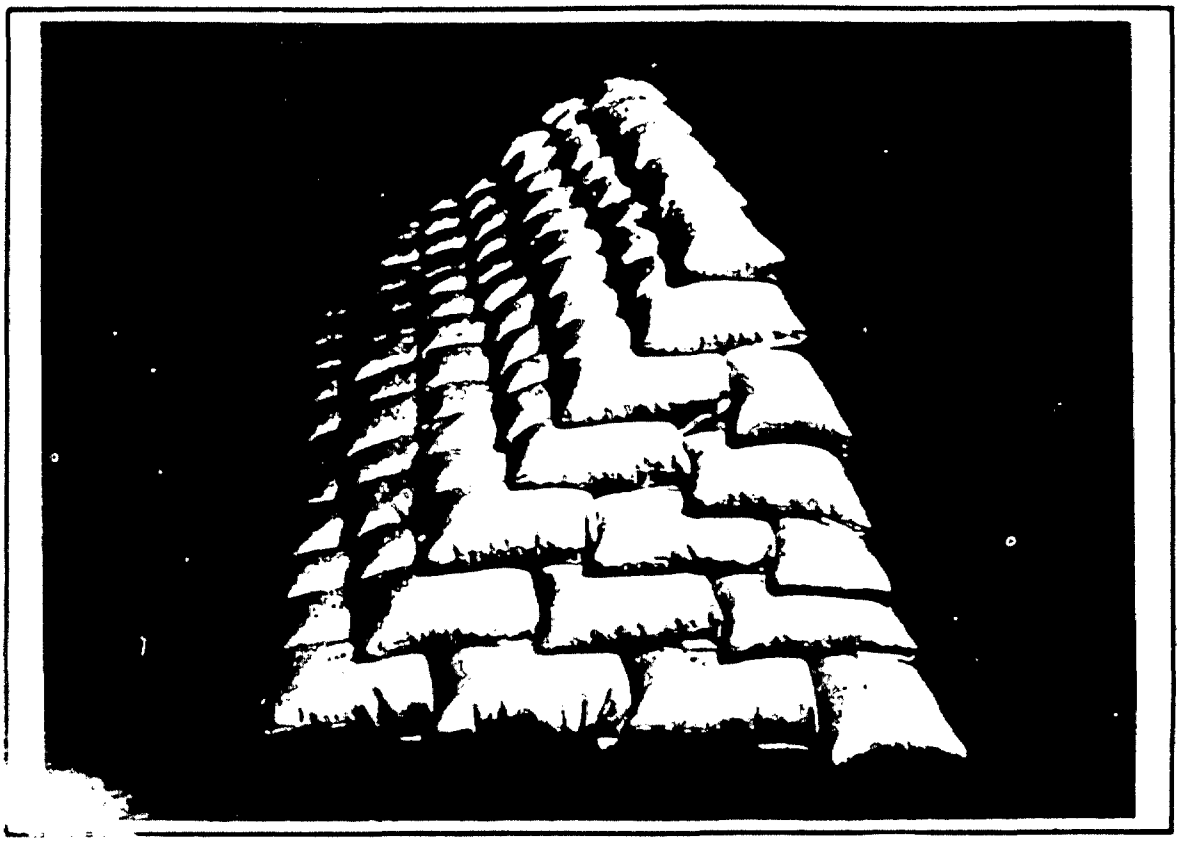
Socks should be laid shingle fashion and not moulded into place.

SACKING SLOUGHS
STANDARD HIGH WATER
MAINTENANCE INSTRUCTION

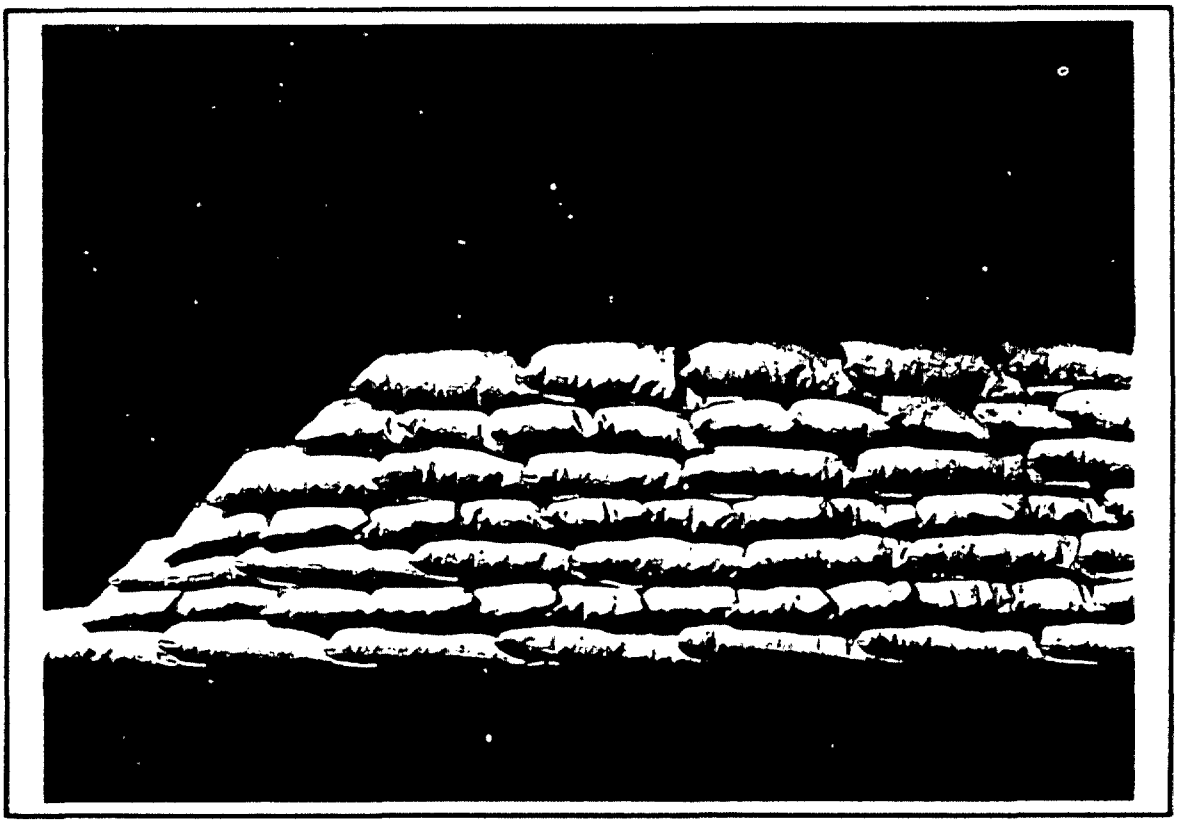
NEW ENGLAND DIVISION

DISASTER OPERATING PROCEDURES
"FLOOD FIGHTING"
ANNEX A

PLATE VII C

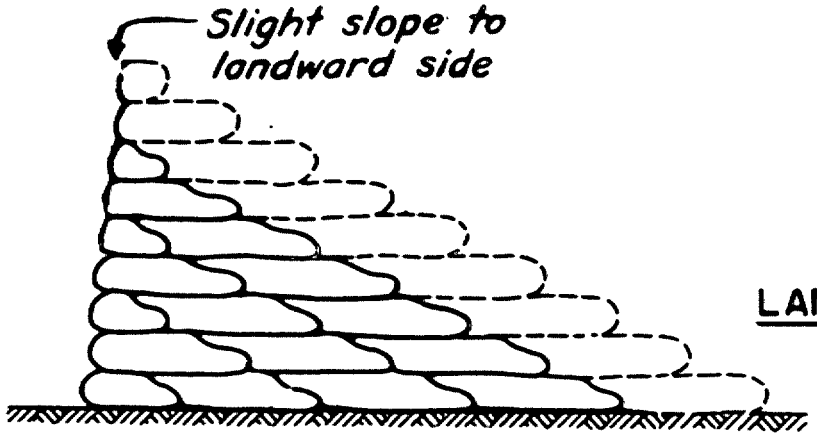


MODEL SACK DIKE OR TOPPING
Typical Section



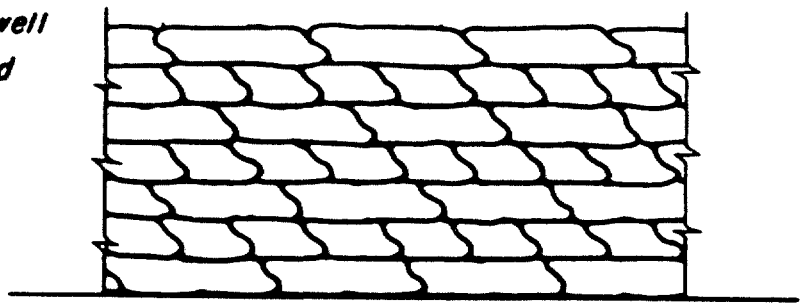
MODEL SACK DIKE OR TOPPING
Riverside View

PLATE VII D



SECTION

Note: Sacks should be lapped at least 1/3 all ways and well mauled or tamped into place.



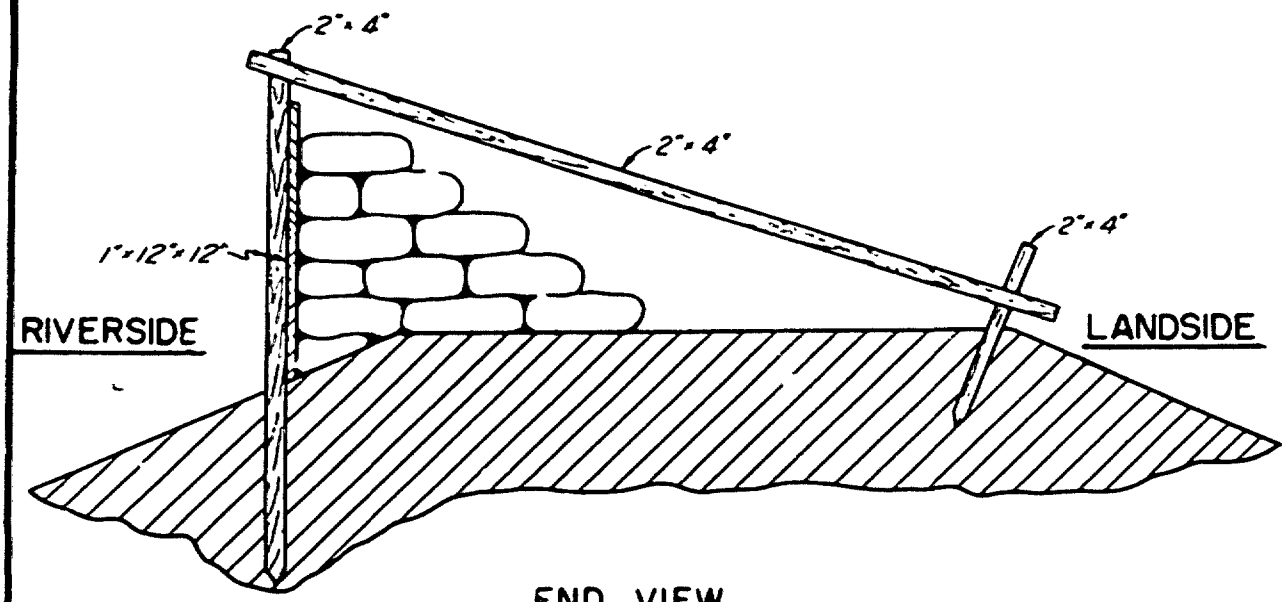
RIVERSIDE ELEVATION

SACKS REQUIRED PER 100' STA.
100 lb. "Feed" Sacks - 1 Cu. Ft. Each

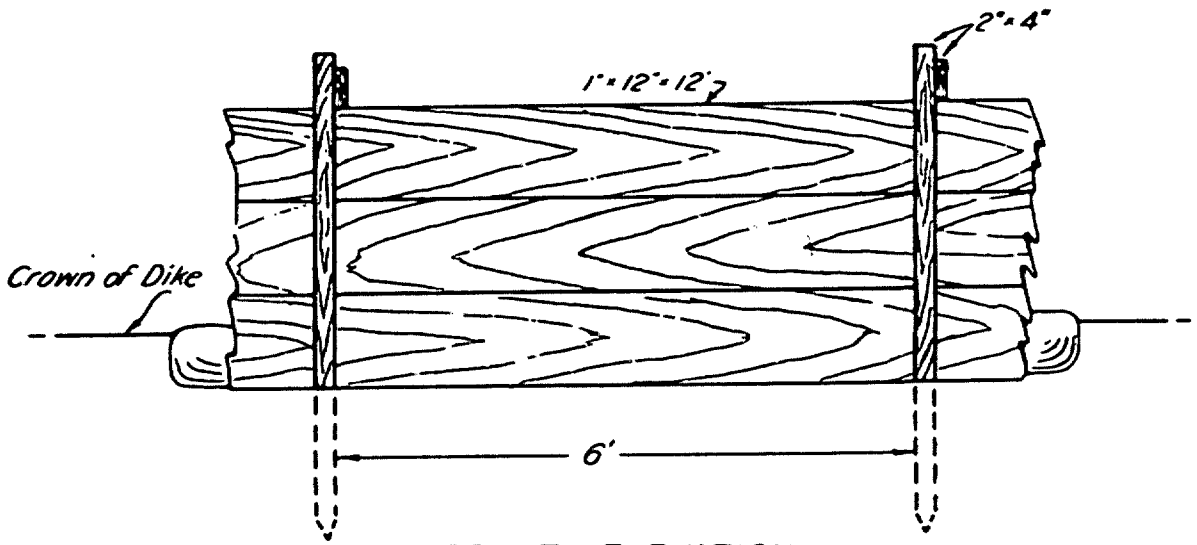
Approx. Hgt. Sack Dike	Sacks High	Required
1.5	3	300
2.0	4	750
3.0	6	1400
4.0	8	2250
5.0	10	3250
6.0	12	4500
7.0	14	5950
8.0	16	7600

SACK DIKE OR TOPPING
STANDARD HIGH WATER
MAINTENANCE INSTRUCTION

NEW ENGLAND DIVISION
DISASTER OPERATING PROCEDURES
"FLOOD FIGHTING"
ANNEX A PLATE VII E



END VIEW



FRONT ELEVATION

BILL OF MATERIAL TO CONSTRUCT 100 FEET

25 pcs. 1"x12"x12'	17 pcs. 2"x4"x6'
17 pcs. 2"x4"x10'	17 pcs. 2"x4"x2'

LUMBER AND SACK TOPPING STANDARD HIGH WATER MAINTENANCE INSTRUCTION

NEW ENGLAND DIVISION

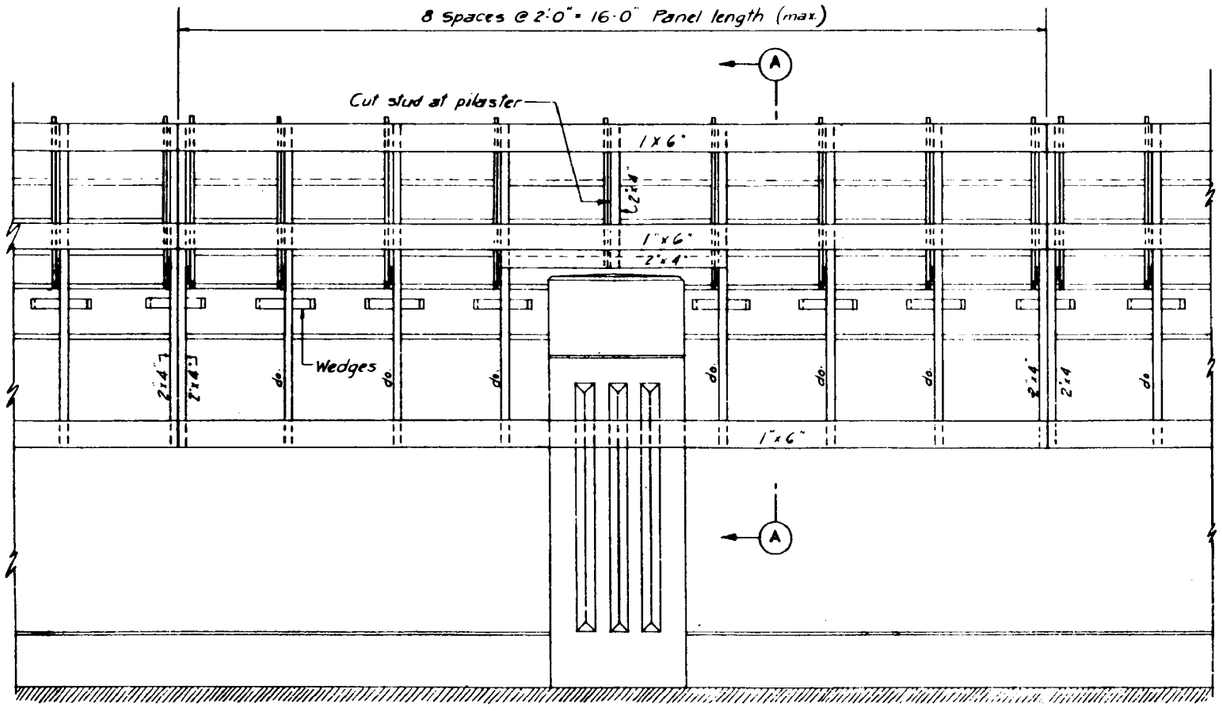
DISASTER OPERATING PROCEDURES

"FLOOD FIGHTING"

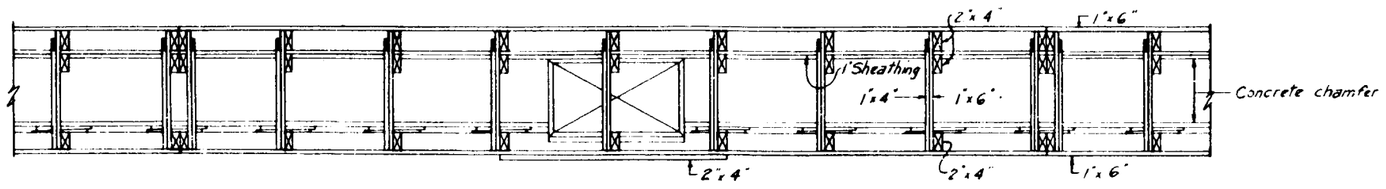
ANNEX A

PLATE VII F

BILL OF MATERIALS		
For one 8'-0" panel. Regular wall section.		
Uprights	10 pcs.	2" x 4" x 6'-0"
Vert. brace	5 "	2" x 4" x 3'-0"
Stringers	5 "	1" x 6" x 8'-0"
Upper ties	5 "	1" x 6" x 2'-3"
Lower ties	5 "	1" x 4" x 2'-3"
Diagonals	5 "	1" x 4" x 3'-6"
Sheathing	6 "	1" x 6" x 8'-0" or random widths to make up 36"
Wedges	8	(½" to 1½") x 2" x 1'-0" = 1-3 x 2 x 4'-0"
For one 8'-0" panel. Pilaster section Same as above list except:		
Substitute one upright 2" x 4" x 2'-9" for one 2" x 4" x 6'-0"		
Add one stringer piece 2" x 4" x 4'-2"		

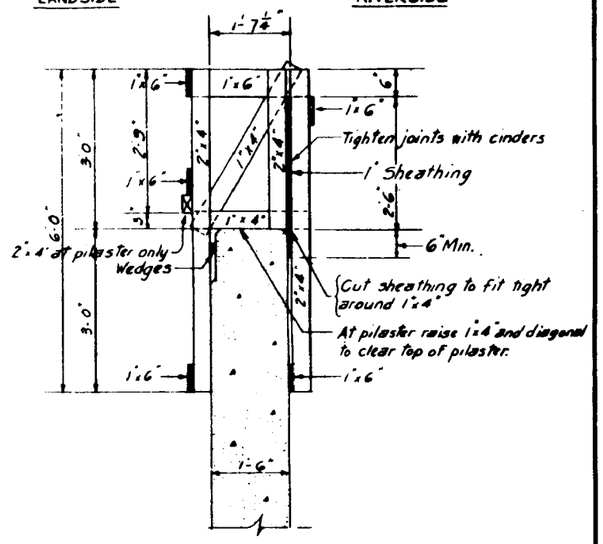


LANDSIDE ELEVATION

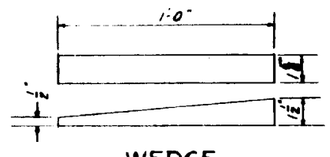


PLAN

LANDSIDE RIVERSIDE



SECTION A-A



WEDGE

EMERGENCY FLASH BOARDS
FOR FLOOD WALLS

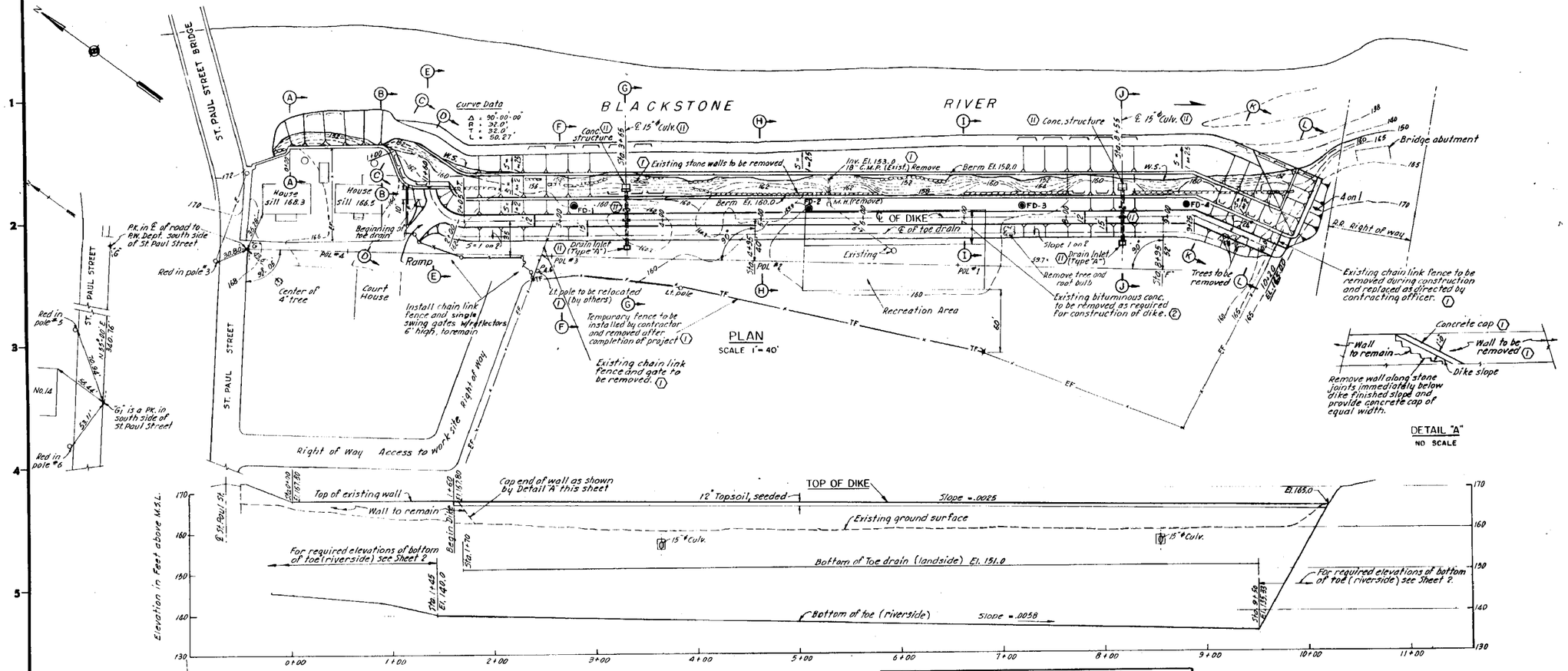
NEW ENGLAND DIVISION

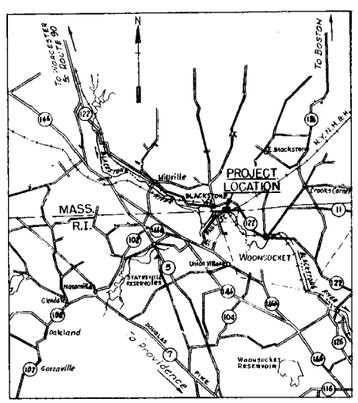
DISASTER OPERATING PROCEDURES
"FLOOD FIGHTING"
ANNEX A PLATE VII G

APPENDIX E

AS-BUILT DRAWINGS

CORPS OF ENGINEERS — U. S. ARMY





VICINITY MAP

1 ½ 0 1 2 3 4 MILES

PROFILE ON ℄ OF DIKE

SCALE HOR. 1" = 40'
VERT. 1" = 10'

FD-1
12 May 1969
El. 160 ±

8	SP	SAND w/ trace of gravel and silt (Fill)
	SP SM	Silty medium to fine SAND (Fill)
9		
	SP	Medium to fine SAND w/ trace of silt.
28	SP GM	Silty sandy GRAVEL

FD-2
12 May 1969
El. 160 ±

5	SM	Silty SAND w/ asphalt and brick fragments (FILL)
6	SP SM	Silty medium to fine SAND w/ trace of gravel (FILL)
	GP	Sandy GRAVEL
20		
	SM	Silty fine SAND
9		

FD-3
12 May 1969
El. 160 ±

7	SM	Silty medium to fine SAND (FILL)
6		
26	GP GM	Silty sandy GRAVEL

FD-4
13 May 1969
El. 159 ±

8	SM	Silty fine SAND (FILL)
	SP	Fine SAND w/ trace of vegetation (FILL)
8	SP SM	Silty fine SAND
	GW	Sandy GRAVEL
11		
7	SM	Silty fine SAND

GRAPHIC LOGS
SCALE 1" = 5'

LEGEND FOR GRAPHIC LOGS

FD-
13 May 1969
El. 159 ±

SM
25

FD- — Foundation test boring.
13 May 1969 — Date exploration completed.
El. 159 ± — Elevation of ground surface.
Subsurface water level in boring at time of exploration.
Group letter symbol according to Unified Soil Classification System.
Blows per foot of penetration considered most representative for each sample drive using a 350 pound hammer with a free fall of about 18" on a standard 2 foot solid sample spoon with a beveled sharpened drive shoe.

GRAPHIC SCALES

1" = 40' — 40' 0 40' 80'
1" = 10' — 10' 0 10' 20'
1" = 5' — 5' 0 5' 10'

INDEX TO DRAWINGS

DRAWING NO.	SHEET NO.	TITLE
BLA-8	1	PLAN, PROFILE, DETAILS AND GRAPHIC LOGS
" -8	2	SECTIONS AND DETAILS
DRAWINGS INCLUDED WITH SPECIFICATIONS		
STD-36	1	SAFETY SIGN
" -21	1	CONST. SIGN
" -43	1	DRAIN INLET, TYPE "A"
" -49	1	TYPE I FRAME
40-16-09	1	FENCING

NOTES

Elevations refer to Mean Sea Level Datum. For details of concrete structure and 15" ϕ culvert see Sheet 2.
For Typical Sections see Sheet 2.
Water surface shown was determined at time of survey.

SAFETY PAYS

REVISION	DATE	DESCRIPTION	BY
		Final field corrections	

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY J.A.M. | DR. BY J.A.M. | CK. BY J.A.M.

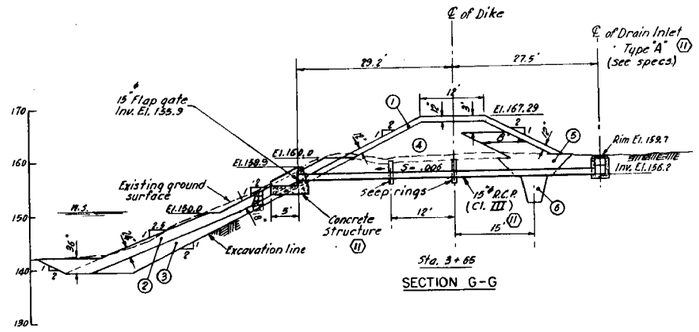
SUBMITTED: Chief, Layout Section
APPROVED RECOMMENDED: Chief, Design Branch
APPROVED: Chief, Plans & Projects Section

BLACKSTONE RIVER FLOOD CONTROL
RESTORATION OF FLOOD CONTROL PROJECT
PLAN, PROFILE, DETAILS AND GRAPHIC LOGS
BLACKSTONE RIVER — BLACKSTONE, MASS
APPROVED: Chief, Engineering Division — DATE MAY 1970

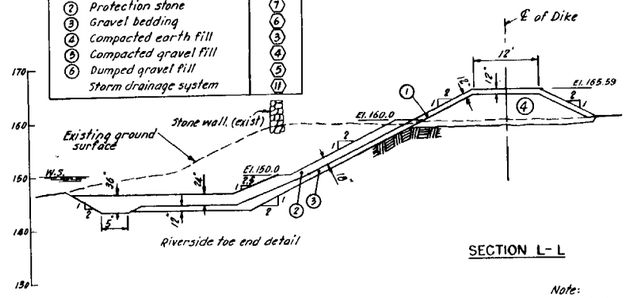
SCALE AS SHOWN | SPEC. NO. DACW 33-70-B-0034
DRAWING NUMBER
BLA - 8
SHEET 1

CORPS OF ENGINEERS — U. S. ARMY

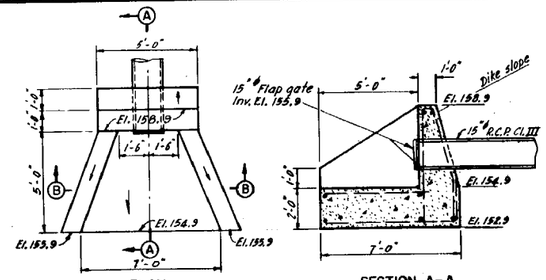
MATERIALS LEGEND	ITEM NO.
① Topsoil, seeded	⑨ ⑩
② Protection stone	7
③ Gravel bedding	6
④ Compacted earth fill	3
⑤ Compacted gravel fill	4
⑥ Dumped gravel fill	5
Storm drainage system	⑪



SECTION G-G

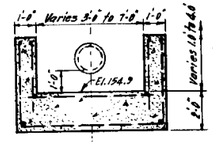


SECTION L-L



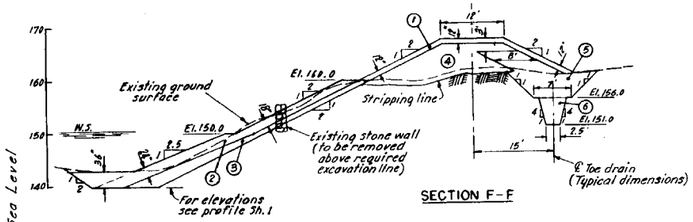
PLAN

SECTION A-A

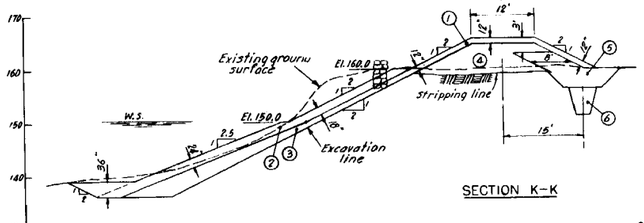


SECTION B-B

Note: All reinforcing bars #3 @ 18" c.c.



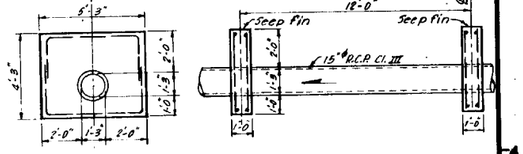
SECTION F-F



SECTION K-K

Note: Toe drain ends at Sta. 10+00

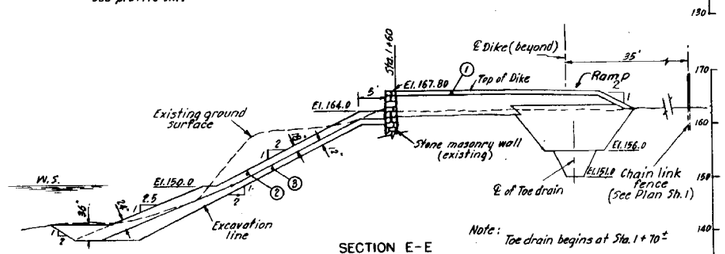
OUTLET STRUCTURE



ELEVATION-SEEP FINS
4 Required

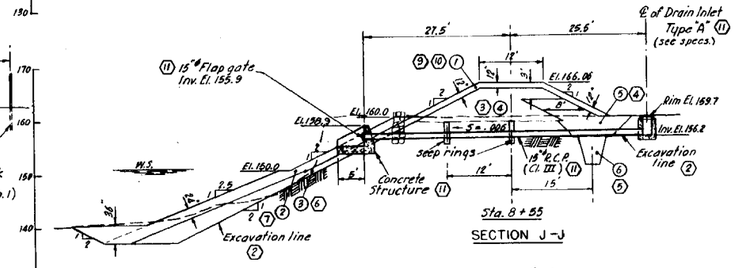
DRAIN DETAILS ⑪
SCALE: 3/8"=1'-0"

Elevation in Feet above Mean Sea Level

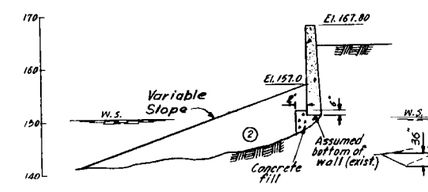


SECTION E-E

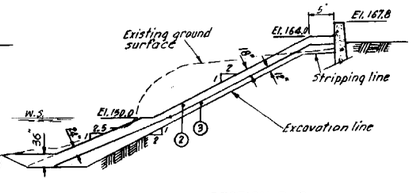
Note: Toe drain begins at Sta. 1+70±



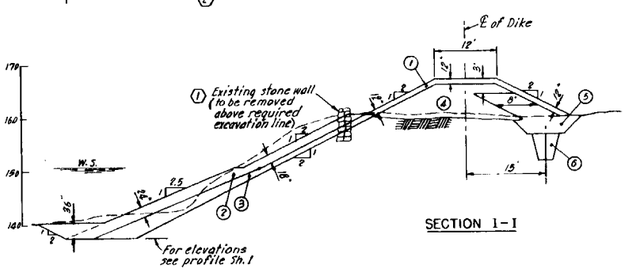
SECTION J-J



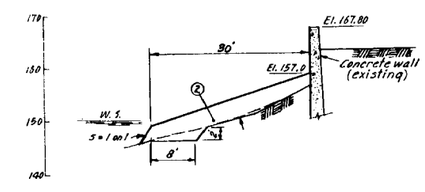
SECTION B-B



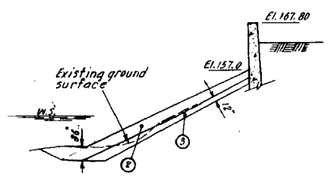
SECTION D-D



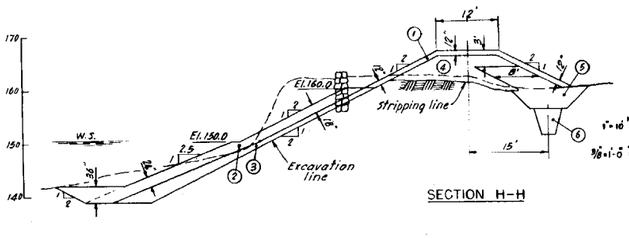
SECTION I-I



SECTION A-A



SECTION C-C
Transition



SECTION H-H

TYPICAL SECTIONS
SCALE 1"=10'

GRAPHIC SCALES
1"=10'
3/8"=1'-0"

SAFETY PAYS

NOTES
For general notes applying to this sheet, see Sheet 1.
Figures in hexagons denote Item Nos. under which payment will be paid.

REVISION	DATE	DESCRIPTION	BY
		Final field corrections	

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION
CORPS OF ENGINEERS
WALTHAM, MASS.

DES. BY J.A.M. | DR. BY J.A.M. | CK. BY J.A.M.

SUBMITTED: CHIEF, LAYOUT SECTION
RECOMMENDED: CHIEF, TECH. ENG. BRANCH
REVIEWED: CHIEF, SURVEY & MAPPING SECTION

BLACKSTONE RIVER FLOOD CONTROL
RESTORATION OF FLOOD CONTROL PROJECT
SECTIONS AND DETAILS
BLACKSTONE RIVER — BLACKSTONE, MASS

APPROVED: CHIEF, ENGINEERING DIVISION
DATE: MAY 1970

SCALE AS SHOWN | SPEC. NO. DACW 33-70-B-0034
DRAWING NUMBER: BLA-8
SHEET 2